Reasons for Missed Diagnosis in Stroke

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Outline

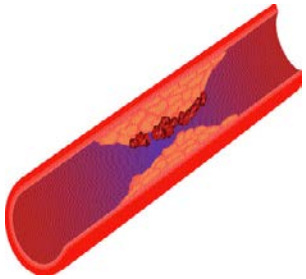
- What is a stroke?
- How do we diagnose it?
- What leads us to miss it sometimes?
- How can we do better?

Defining Stroke

- Sudden brain damage
- Lack of blood flow to the brain caused by a clot or rupture of a blood vessel

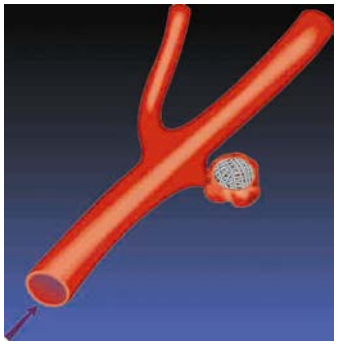
Ischemic = Clot

(makes up approximately 87% of all strokes)

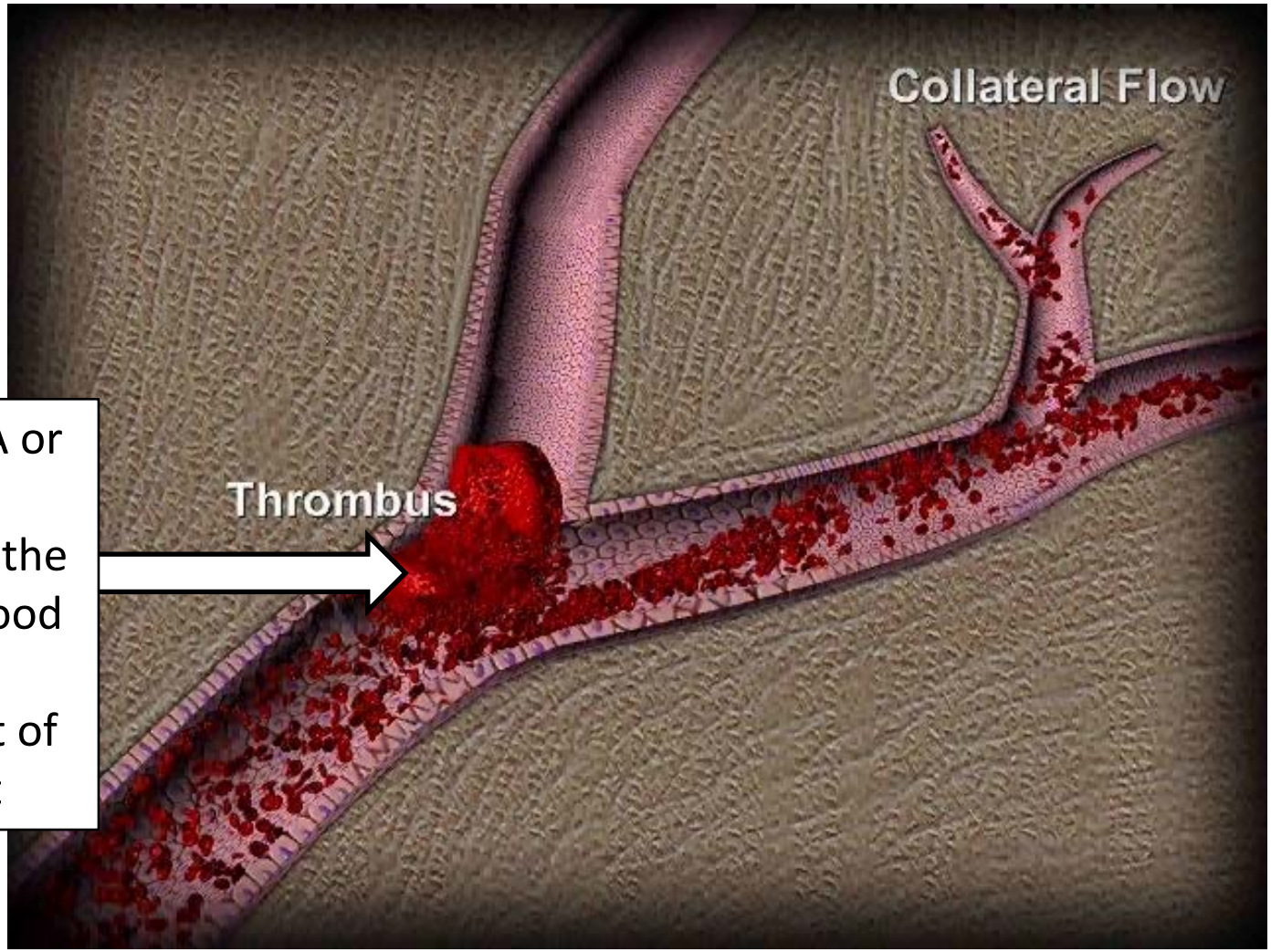


Hemorrhagic = Bleed

- Bleeding around brain
- Bleeding into brain



Undoing An Ischemic Stroke



If given early, TPA or EVT can dissolve/remove the clot, restoring blood flow so the downstream part of the brain doesn't have to die

Diagnosis Is By History and Exam

Sudden onset, Localization of symptoms/signs to a vascular distribution

Left MCA:	Right MCA:	Brainstem:
Aphasia	Severe left neglect	Ataxia/nausea/vomiting
Left gaze preference	Right gaze preference	**Whole side of** face droop
Right lower face droop	Left lower face droop	Abnormal eye position
Right paralysis	Left paralysis	Crossed motor signs
Right numbness	Left numbness	Crossed sensory modalities
		Dysarthria/dysphagia

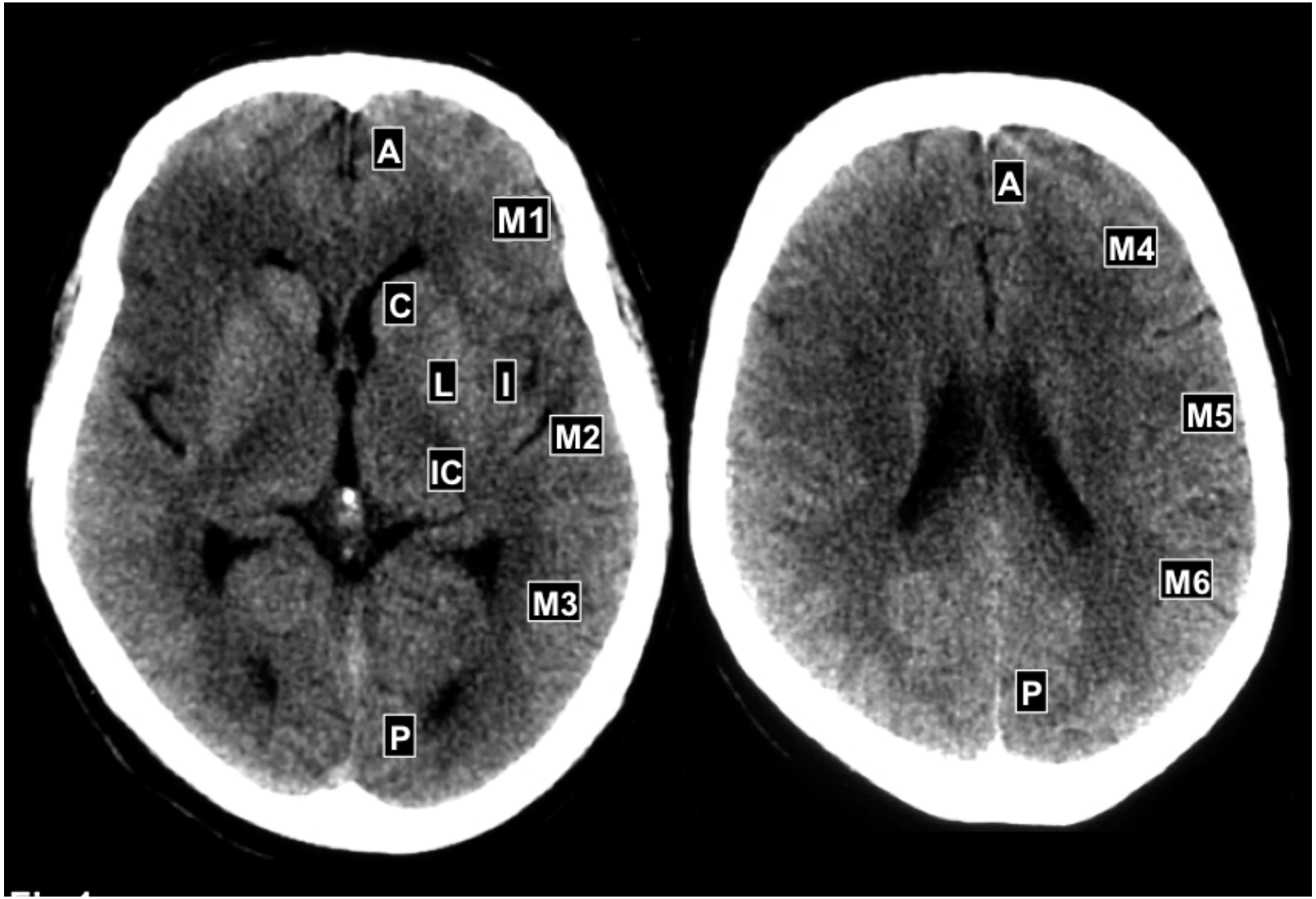
Stroke Mimics

- **Truly acute onset**
  - **Seizure (primary/secondary)**
  - **Complicated Migraine**

- Others
  - Stroke recrudescence
  - Hypoglycemia
  - Hypertensive emergency
  - Hyperglycemia
  - Meningitis / Encephalitis
  - Conversion disorder
  - Bell's Palsy
  - Transient global amnesia

CT SCAN – Rule Out Blood

CT Scan – Early Ischemic Changes
ASPECTS 10-3 (I, M1, M4) = 7



NIH Stroke Scale asa.trainingcampus.net

1. Level of consciousness
   - 0 alert
   - 1 drowsy
   - 2 stuporous
   - 3 coma

2. LOC questions (month, age)
   - 0 both correct
   - 1 one correct
   - 2 incorrect

3. LOC commands (close eyes, make a fist)
   - 0 both correct
   - 1 one correct
   - 2 incorrect

4. Best gaze
   - 0 normal
   - 1 partial gaze palsy
   - 2 forced deviation

5. Visual fields
   - 0 no visual loss
   - 1 partial hemi
   - 2 complete hemi
   - 3 bilateral hemi

6. Facial palsy
   - 0 normal
   - 1 minor
   - 2 partial
   - 3 complete

7-10. Motor (L/R arm + leg)
   - 0 no drift
   - 1 drift
   - 2 can't resist gravity
   - 3 no effort against gravity
   - 4 no movement
   - 9 amputation/joint fusion

11. Limb ataxia (FNF, HKS)
   - 0 absent
   - 1 present in one limb
   - 2 present in 2 limbs

12. Sensation (pin)
   - 0 normal
   - 1 partial loss
   - 2 severe loss

13. Best language
   - 0 no aphasia
   - 1 mild-mod aphasia
   - 2 severe aphasia
   - 3 mute

14. Dysarthria
   - 0 none
   - 1 mild-mod
   - 2 near to unintelligible or worse
   - 9 intubated/barrier

15. Extinction and inattention
   - 0 no neglect
   - 1 partial neglect
   - 2 complete neglect

Public Awareness of Stroke Diagnosis

GCNKSS and Massachusetts DPH

Courtesy of Jeyaraj Pandian

Abnormal sign = ~70% chance of stroke

Call 9-1-1 in US

- Faster time to treatments than driving to emergency department

Arrival by EMS	
Yes (57%)	2.0 (1.0–4.6)
No	3.9 (1.7–9.4)

Morris, Stroke, 2000

AHA Class I, Level B Recommendation

EMS vs Dispatcher Dx of Stroke

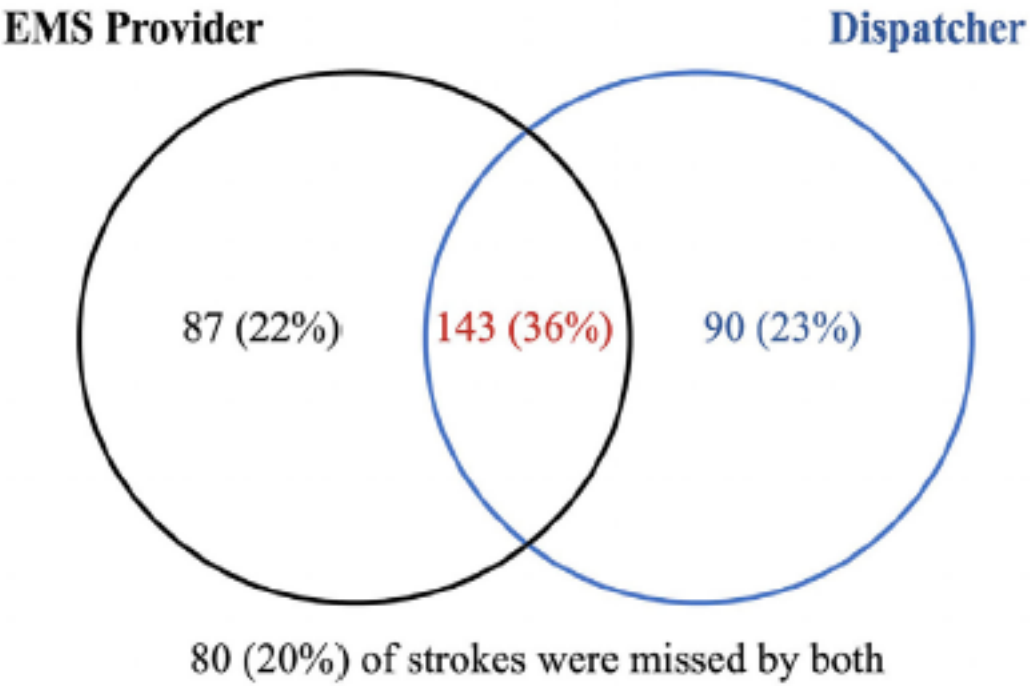


FIGURE 1 | Overlap between emergency medical services (EMS) crew and dispatcher stroke identification. Of the 400 patients with a confirmed vascular event, 87 (22%) were correctly identified by the EMS crew alone, 90 (23%) by the dispatcher alone, and 143 (36%) by both.

Jia, 2017

Public Stroke Awareness in US

Open ended question of stroke warning signs.

The sudden onset of

(1) numbness or weakness of the face, arm, or leg;

(2) confusion or trouble speaking or understanding speech;

(3) trouble seeing in one or both eyes;

(4) trouble walking, dizziness, or loss of balance or coordination; and

(5) severe headache with no known cause.

Table 3. Comparison of Knowledge of Stroke Warning Signs and Risk Factors Between Survey Years, Greater Cincinnati/Northern Kentucky Population

	1995 (N=1880)	2000 (N=2173)	2005 (N=2156)
No. of correct risk factors known			
0	606 (32.2%)	620 (28.5%)	624 (28.9%)
1	827 (44.0%)	899 (41.4%)	829 (38.4%)
2	398 (21.2%)	571 (26.3%)	600 (27.8%)
3	49 (2.6%)	83 (3.8%)	103 (4.8%)

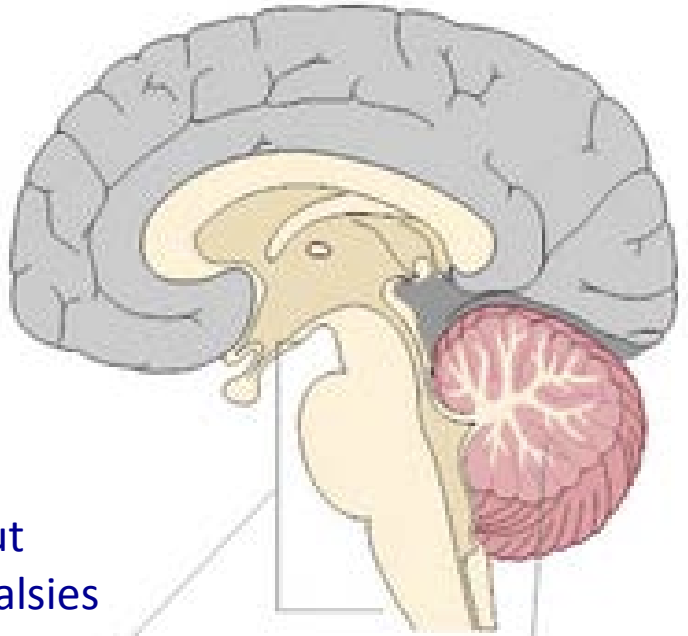
Kleindorfer, 2009

EMS Diagnosis of Stroke

- Good diagnostic accuracy
  - Dx of abnormality in any 1 of the 3 stroke scale items had a sensitivity of 66% and specificity of 87% in identifying a stroke patient. Sensitivity was 88% for identification of patients with anterior circulation strokes. (Kothari, 1999)
  - Dx correct in 144 of 183 (79%) stroke patients who initially presented to them. (Harbison, 2003)
  - Dx of 278 suspected stroke patients of whom 217 (78%) had confirmed stroke (n=189) or TIA (n=28) (Nor, 2004)
- Many missed by FAST are posterior circulation strokes
  - FAST did not detect 38% of posterior cerebral circulation strokes. (Nor, 2004)

Posterior Circulation Stroke

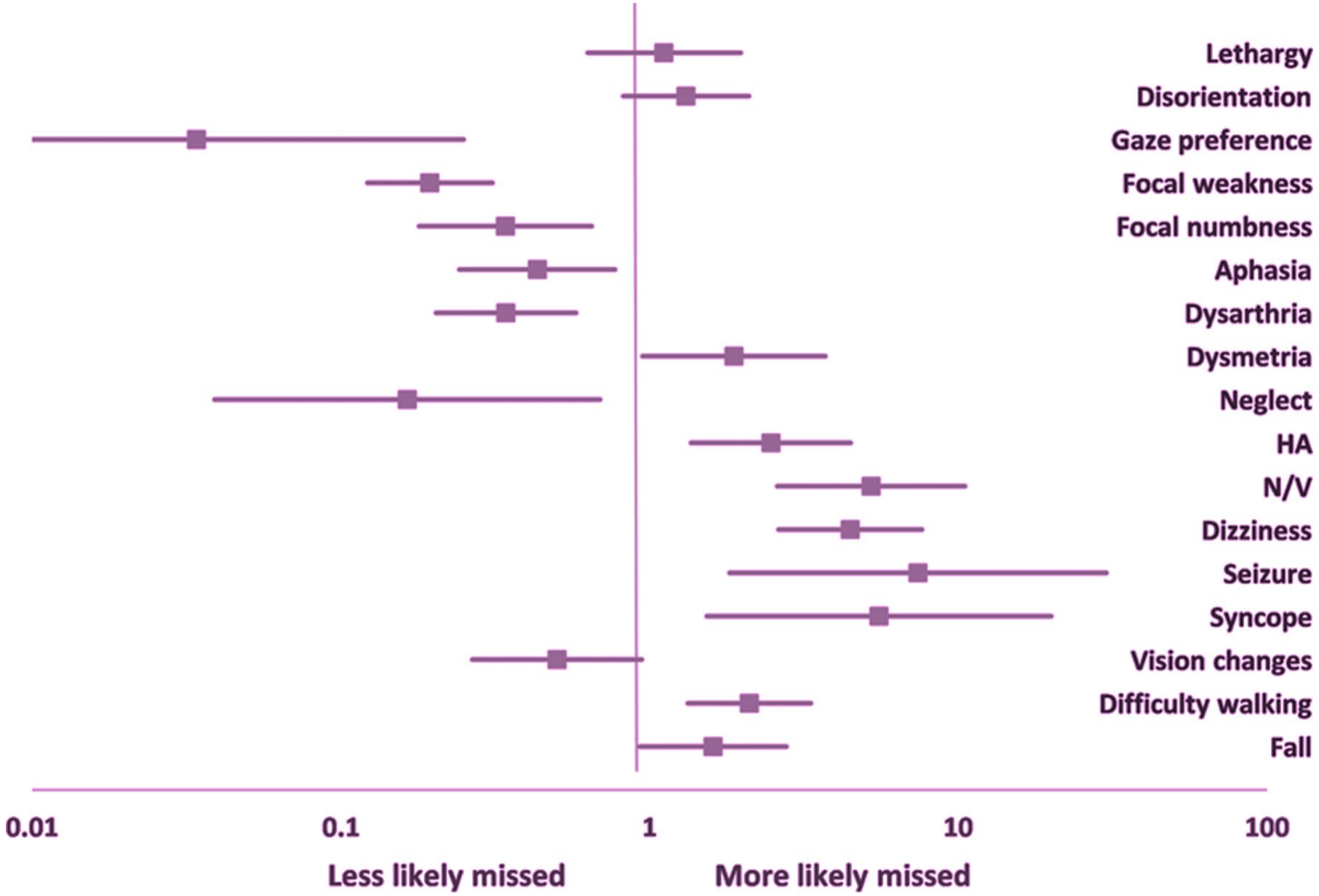
- ~20% of ischemic strokes
- Brainstem and cerebellum
- "5Ds": dizziness, diplopia, dysarthria, dysphagia, and dystaxia.



Vision field cut
Extraocular palsies
Gaze deviation
Vertical skew
Upper/lower face droop
Crossed motor signs
Crossed sensory modalities
Dysarthria
Dysphagia
Vertigo

Incoordination
Action tremor
Dysarthria
Nausea/Vomiting
Vertigo

Symptoms in Missed Stroke Dx in ED



Stroke. 2016;47:668-673

Symptoms in Missed Stroke Dx

Discussion

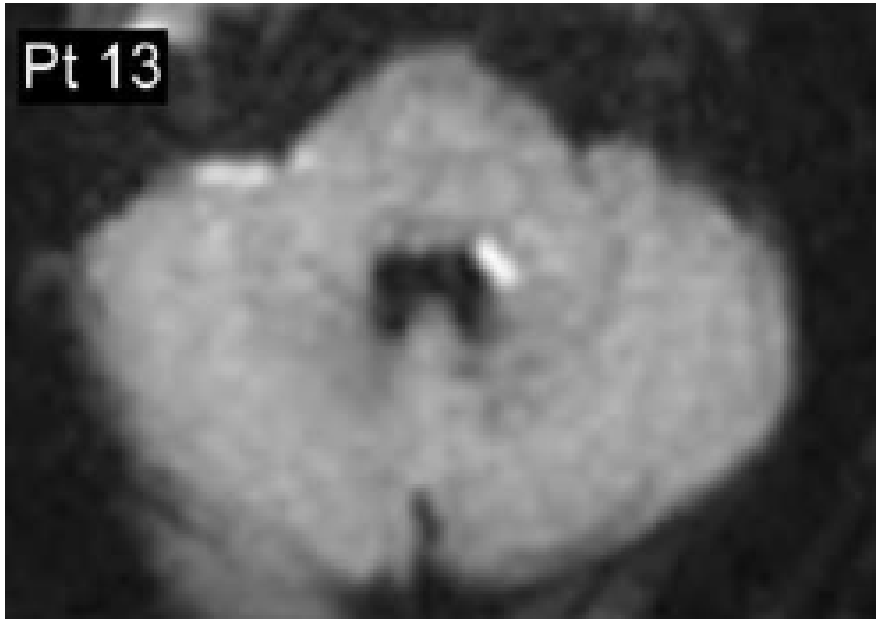
Despite having certified stroke programs, >20% of acute ischemic strokes were missed in the ED in both the academic medical center and community regional referral hospital. Posterior circulation strokes were nearly 3× more likely than anterior strokes to be missed. The symptoms that were the biggest predictors of missed strokes—nausea/vomiting and dizziness—are frequently associated with posterior circulation strokes.

done. Completing a systematic review of systems and examination is a fast, cost-effective way to ensure that neurological findings are not being missed.

Stroke. 2016;47:668-673

False Negative Initial MRI

Small strokes (≤10 mm), % (n of 15)	Large strokes (>10 mm), % (n of 90)	*p* Value
53.3 (8)	7.8 (7)	<0.001



Tehrani, 2014

SAEM Academic Emergency Medicine
Official Journal of the Society for Academic Emergency Medicine
Explore this journal >

Pitfalls in the Diagnosis of Cerebellar Infarction

Sean I. Savitz MD ✉, Louis R. Caplan MD, Jonathan A. Edlow MD

First published: January 2007 Full publication history

DOI: 10.1197/j.aem.2006.06.060 View/save citation

View issue TOC
Volume 14, Issue 1
January 2007
Pages 63–68

Potential Pitfalls in the Diagnosis of Cerebellar Infarction

Related to the clinical examination
1. Failure to recognize that young patients without traditional vascular risk factors can have strokes
2. Failure to understand the spectrum of presenting complaints of cerebellar stroke
   a. Failure to recognize that vomiting can be a prominent chief complaint
3. Failure to properly perform and correctly interpret the findings of neurologic examination, particularly
   a. Gait testing
   b. Nystagmus
4. Overfixation on prior neurologic or other medical conditions

Related to diagnostic testing
1. Failure to perform brain imaging
2. Failure to recognize the limitations in brain imaging
   a. Particularly, computed tomographic scanning in acute brain ischemia
   b. Rarely, with magnetic resonance scanning
3. Failure to perform tests to define the underlying vascular lesion

Related to establishing a diagnosis and disposition
1. Failure to arrive at a specific diagnosis that fully explains the clinical data
2. Failure to consider in-hospital observation in ambiguous cases
3. Failure to obtain neurologic consultation in difficult cases

Savitz, 2007

THE LANCET
Neurology

Volume 10, Issue 6, June 2011, Pages 550-560

Review

Atypical presentations of acute cerebrovascular syndromes

Jonathan A Edlow MD [a, b], Magdy H Selim MD [a, c]

- First, clinicians should suspect stroke in any patient with abrupt onset of neurological symptoms.
- Second, clinicians should be aware that some patients will initially present with various uncommon and atypical stroke symptoms.
- Third, a complete and systematic neurological examination should be routinely done in patients presenting with acute neurological symptoms because this might shed light on the true nature of the problem.
- Finally, clinicians should be aware that even with the most sophisticated neuroimaging tests, stroke might be missed in the early hours after the event.

Edlow, 2007

Non Classic Acute Stroke Presentations

Non-localising symptoms

- Neuropsychiatric symptoms
- Acute confusional state
- Altered level of consciousness

Abnormal movements or seizures

- Abnormal movements
- Limb-shaking transient ischaemic attacks
- Seizures
- Alien hand syndrome
- Localised asterixis
- Isolated hemifacial spasms
- Disappearance of previous essential tremor

Peripheral nervous system symptoms

- Acute vestibular syndrome
- Other cranial nerve palsies (especially third and seventh cranial nerves)
- Acute monoparesis
  - Cortical hand syndrome
  - Cortical foot syndrome
- Isolated sensory symptoms

Atypical symptoms

- Isolated dysarthria
- Isolated dysarthria-facial paresis syndrome
- Isolated visual symptoms
  - Anton's syndrome (cortical blindness with denial of deficit)
  - Balint's syndrome
  - Isolated visual field disturbances
- Foreign accent syndrome
- Isolated dysphagia or stridor

Isolated headache

- Subarachnoid haemorrhage
- Cerebral venous sinus thrombosis
- Cervical artery dissections
- Cerebellar infarction

Acute neurological syndrome with negative brain imaging

- Negative non-contrast CT in subarachnoid haemorrhage, cerebral venous sinus thrombosis, arterial dissection, and acute ischaemic stroke
- Negative MRI in acute ischaemic stroke

Edlow, 2007

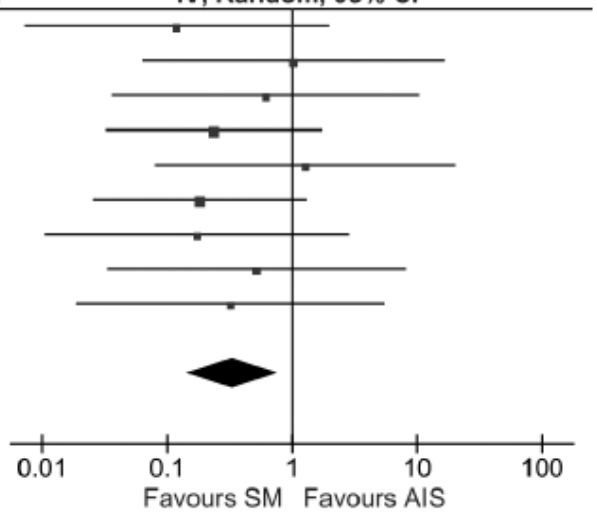
Stroke Mimics and IV rtPA

A

Study or Subgroup	Stroke Mimics Events	Stroke Mimics Total	Acute ischemic Stroke Events	Acute ischemic Stroke Total	Weight	Risk Ratio IV, Random, 95% CI
Houston	0	69	24	406	9.0%	0.12 [0.01, 1.93]
Madrid	0	15	18	606	9.2%	1.03 [0.06, 16.28]
Mannheim	0	42	11	606	8.9%	0.61 [0.04, 10.24]
Memphis	1	75	29	516	17.9%	0.24 [0.03, 1.72]
Michigan	0	6	8	151	9.3%	1.28 [0.08, 19.97]
Multicenter	1	100	275	4995	18.4%	0.18 [0.03, 1.28]
Phoenix	0	56	24	483	9.0%	0.17 [0.01, 2.81]
Pittsburgh	0	9	21	222	9.4%	0.52 [0.03, 7.96]
St. Louis	0	20	7	100	8.8%	0.32 [0.02, 5.40]
Total (95% CI)		**392**		**8085**	**100.0%**	**0.33 [0.14, 0.77]**
Total events	2		**417**			

Heterogeneity: Tau² = 0.00; Chi² = 3.06, df = 8 (P = 0.93); I² = 0%

Test for overall effect: Z = 2.58 (P = 0.010)



Tsivgoulis, Stroke, 2015

Conclusions

- Stroke is a clinical diagnosis
- FAST is a helpful guide but consider any SUDDEN loss of function a sign of possible stroke
- Routinely do neuro exams and consult your stroke specialist (neurologist, some ED MDs, NPs, etc)
- Err towards treating when not sure if stroke if otherwise eligible for thrombolysis